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# RECENT ADVANCES IN CIRCUITS

Proceedings of the 13th WSEAS  
International Conference on CIRCUITS

WSEAS CSCC Multiconference  
Rodos (Rhodes) Island, Greece, July 22-24, 2009

Recent Advances in Electrical Engineering  
A Series of Reference Books and Textbooks

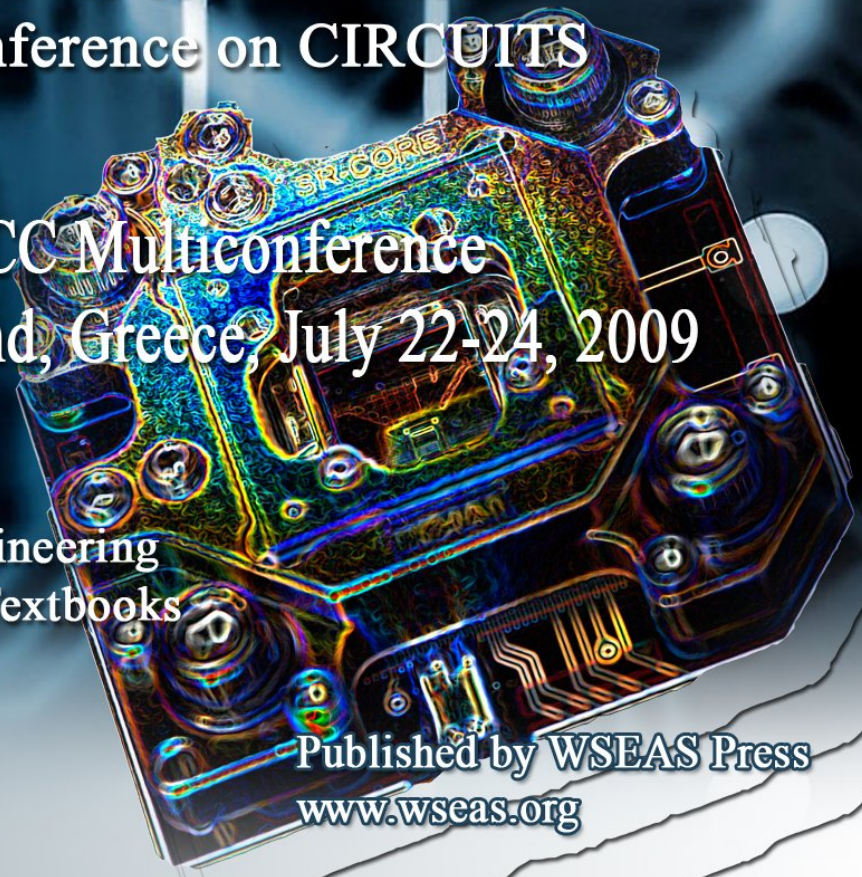
ISBN: 978-960-474-096-3

ISSN: 1790-5117

Published by WSEAS Press

[www.wseas.org](http://www.wseas.org)

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CENTRO DE INVESTIGAÇÃO SOBRE  
ESPAÇO E ORGANIZAÇÕES



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All papers of the present volume were peer reviewed by two independent reviewers. Acceptance was granted when both reviewers' recommendations were positive.  
See also: <http://www.worldses.org/review/index.html>

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ISBN: 978-960-474-096-3



World Scientific and Engineering Academy and Society

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**Preface**

This year the 13th WSEAS International Conference on CIRCUITS was held in Rodos, Greece, in July 22-24, 2009. The Conference remains faithful to its original idea of providing a platform to discuss nanostructures and nanotechnologies, molecular electronics, microelectronics, microcircuits, laser and optical systems, nonlinear circuits, electron devices for power technology etc. with participants from all over the world, both from academia and from industry.

Its success is reflected in the papers received, with participants coming from several countries, allowing a real multinational multicultural exchange of experiences and ideas.

The accepted papers of this conference are published in this Book that will be indexed by ISI. Please, check it: [www.worldses.org/indexes](http://www.worldses.org/indexes) as well as in the CD-ROM Proceedings. They will be also available in the E-Library of the WSEAS. The best papers will be also promoted in many Journals for further evaluation.

A Conference such as this can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors



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## Keynote Lecture 1

### Embedded Systems Design – Scientific Challenges and Work Directions



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**Abstract:** The development of a satisfactory Embedded Systems Design Science provides a timely challenge and opportunity for reinvigorating Computer Science. Embedded systems are components integrating software and hardware jointly and specifically designed to provide given functionalities, which are often critical. They are used in many applications areas including transport, consumer electronics and electrical appliances, energy distribution, manufacturing systems, etc. Embedded systems design requires techniques taking into account extra-functional requirements regarding optimal use of resources such as time, memory and energy while ensuring autonomy, reactivity and robustness. Jointly taking into account these requirements raises a grand scientific and technical challenge: extending Computer Science with paradigms and methods from Control Theory and Electrical Engineering. Computer Science is based on discrete computation models not encompassing physical time and resources which are by their nature very different from analytic models used by other engineering disciplines.

We summarize some current trends in embedded systems design and point out some of their characteristics, such as the chasm between analytical and computational models, and the gap between safety critical and best-effort engineering practices. We call for a coherent scientific foundation for embedded systems design, and we discuss a few key demands on such a foundation: the need for encompassing several manifestations of heterogeneity, and the need for design paradigms ensuring constructivity and adaptivity.

We discuss main aspects of this challenge and associated research directions for different areas such as modeling, programming, compilers, operating systems and networks.

**Brief Biography of the Speaker:** Joseph Sifakis is a CNRS researcher and the founder of Verimag laboratory (<http://www.verimag.imag.fr/>), in Grenoble, France. He holds the INRIA-Schneider endowed industrial chair since September 1st 2008. He studied Electrical Engineering at the Technical University of Athens and Computer Science at the University of Grenoble. Verimag is a leading research laboratory in the area of critical embedded systems. It developed the underlying theory and technology for the SCADE tool, used by Airbus for the design and validation of its critical real-time systems, and is becoming a de facto standard for aeronautics. Verimag has a lasting and strategic collaboration with ST Microelectronics, France Telecom R&D, and Airbus, through which numerous results on validation and testing have been transferred. Joseph Sifakis is recognized for his pioneering work on both theoretical and practical aspects of Concurrent Systems Specification and Verification. He contributed to emergence of the area of model-checking, currently the most widely-used method for the verification of industrial applications. His current research activities include component-based design, modeling, and analysis of real-time systems with focus on correct-by-construction techniques (<http://www.verimag.imag.fr/~sifakis/>). Joseph Sifakis has broad experience with industry, notably through joint projects with partners such as Astrium, the European Space Agency, France Telecom, ST Microelectronics and he has also been active for many years in consulting. Joseph Sifakis is the Scientific Coordinator of the European Network of Excellence ARTIST2 on Embedded Systems Design. (<http://www.artist-embedded.org/>). This network gathers 35 of the best European teams in the area, and aims to produce innovative results for cost-effective design of dependable embedded systems. It will also promote innovative methods safe and secure systems, notably through cooperation with key European industrial partners such as Thales, Airbus, Ericsson, Philips, and ST Microelectronics. Joseph Sifakis is the director of the CARNOT Institute "Intelligent Software and Systems" in Grenoble (<http://www.carnot-lsi.com/>). Joseph Sifakis is a member of the editorial board of several journals, co-founder of the International Conference on Computer Aided Verification (CAV) and a member of the Steering Committee of the EMSOFT (Embedded Software) conference. He is a member of Academia Europea (<http://www.academiaeuropea.org/>) and a member of the French National Academy of Engineering (<http://www.academie-technologies.fr/>).

Joseph Sifakis has received with Ed Clarke and Allen Emerson for their contribution to Model Checking, the Turing Award for 2007 (<http://awards.acm.org/homepage.cfm?srt=all&awd=140>). He is also the recipient of the CNRS Silver Medal in 2001.

## Keynote Lecture 2

### Quantum Cryptography and Chaos Functions: The Ultimate for Network Security



#### **Professor Stamatios Kartalopoulos**

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**Abstract:** As the sophistication of intruders' increases, so does the incidents of information integrity breaches and network attacks. In response, very complex cryptographic processes have started being employed, such as chaos theory and quantum theory, in an effort to create the "holy grail" of cryptographic systems and network security. Quantum theory defines the non-classical qubit, which is the superposition of quantum states having no classical analog. In addition, it is based on the "no cloning" or "no copying" theorem and on Heisenberg's uncertainty. Both, the qubit and the no-cloning theorem, along with the quantum-mechanical properties of photons, have been applied to a new breed of cryptography and secure optical communication networks known as quantum cryptography and quantum networks, respectively.

Chaos is based on the particular behavior of certain non-linear functions, which for a minute change of parameters produce a very large and unstable output, known as the "chaotic regime". However, this chaos is reproducible, which also makes it attractive to secure communications.

In this talk we explain quantum cryptographic protocols as well as chaos and chaotic processes with simple examples. We then describe how chaos functions are used in quantum cryptography in order to increase efficiency and speed of the quantum key establishment.

**Brief Biography of the Speaker:** Stamatios V. Kartalopoulos, PhD, is currently the Williams Professor in Telecommunications Networking at the University of Oklahoma. His research emphasis is on optical communication networks (FSO, long haul and FTTH), optical technology including optical metamaterials, and optical communications security including quantum cryptography and key distribution. Prior to this, he was with Bell Laboratories where he defined, led and managed research and development teams in the areas of DWDM networks, SONET/SDH and ATM, Cross-connects, Switching, Transmission and Access systems. He has received the President's Award and many awards of Excellence.

He holds nineteen patents in communications networks, and has published more than hundred fifty scientific papers, nine reference textbooks important in advanced fiber optic communications and security, and has also contributed several chapters to other books.

He has been an IEEE and a Lucent Technologies Distinguished Lecturer and has lectured at international Universities, at NASA and conferences. He has been keynote speaker of major international conferences, has moderated executive forums, has been a panelist of interdisciplinary panels, and has organized symposia, workshops and sessions at major international communications conferences.

Dr Kartalopoulos is an IEEE Fellow, chair and founder of the IEEE ComSoc Communications & Information Security Technical Committee, member at large of IEEE New Technologies Directions Committee, and has served editor-in-chief of IEEE Press, chair of ComSoc Emerging Technologies and of SPCE Technical Committees, Area-editor of IEEE Communications Magazine/Optical Communications, member of IEEE PSPB, and VP of IEEE Computational Intelligence Society.

## Keynote Lecture 3

### Content-Adaptive Efficient Resource Allocation for Packet-Based Video Transmission



#### Professor Aggelos K. Katsaggelos

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**Abstract:** Supporting video communication over lossy channels such as wireless networks and the Internet is a challenging task due to the stringent quality of service (QoS) required by video applications and the many channel impairments. Two important QoS characteristics for video are the degree of signal distortion and the transmission delay. Another important consideration is the cost associated with transmission, for example, the energy consumption in the wireless channel case and the cost for differentiated services in the Internet (with DiffServ) case.

In this presentation we consider the joint adaptation of the source coding parameters, such as the quantization step-size and prediction mode, along with the physical layer resources, such as the transmission rate and power. Our goal is to provide acceptable QoS while taking into account system constraints such as the energy utilization. We discuss a general framework that allows a number of "resource/distortion" optimal formulations for balancing the requirements of different applications. We conclude the presentation with some of the grand opportunities and challenges in designing and developing video communication systems.

**Brief Biography of the Speaker:** Aggelos K. Katsaggelos received the Diploma degree in electrical and mechanical engineering from the Aristotelian University of Thessaloniki, Greece, in 1979 and the M.S. and Ph.D. degrees both in electrical engineering from the Georgia Institute of Technology, in 1981 and 1985, respectively. In 1985 he joined the Department of Electrical Engineering and Computer Science at Northwestern University, where he is currently professor. He is also the Director of the Motorola Center for Seamless Communications and a member of the Academic Affiliate Staff, Department of Medicine, at Evanston Hospital.

Dr. Katsaggelos is a member of the Publication Board of the IEEE Proceedings, the IEEE Technical Committees on Visual Signal Processing and Communications, and Multimedia Signal Processing, the Editorial Board of Academic Press, Marcel Dekker: Signal Processing Series, Applied Signal Processing, and Computer Journal. He has served as editor-in-chief of the IEEE Signal Processing Magazine (1997-2002), a member of the Publication Boards of the IEEE Signal Processing Society, the IEEE TAB Magazine Committee, an Associate editor for the IEEE Transactions on Signal Processing (1990-1992), an area editor for the journal Graphical Models and Image Processing (1992-1995), a member of the Steering Committees of the IEEE Transactions on Image Processing (1992-1997) and the IEEE Transactions on Medical Imaging (1990-1999), a member of the IEEE Technical Committee on Image and Multi-Dimensional Signal Processing (1992-1998), and a member of the Board of Governors of the IEEE Signal Processing Society (1999-2001). He is the editor of Digital Image Restoration (Springer-Verlag 1991), coauthor of Rate-Distortion Based Video Compression (Kluwer 1997), co-editor of Recovery Techniques for Image and Video Compression and Transmission, (Kluwer 1998), and co-author of Super-Resolution for Images and Video, (Morgan and Claypool, 2007), and co-author of Joint Source-Channel Video Transmission (Morgan and Claypool 2007). He was the holder of the Ameritech Chair of Information Technology (1997-2003), and he is the co-inventor of twelve international patents, a Fellow of the IEEE (1998) and SPIE (2009), and the recipient of the IEEE Third Millennium Medal (2000), the IEEE Signal Processing Society Meritorious Service Award (2001), an IEEE Signal Processing Society Best Paper Award (2001), an IEEE ICME Best Paper Award (2006), and an IEEE ICIP Paper Award (2007). He was a Distinguished Lecturer of the IEEE Signal Processing Society for 2007-2008.



## Keynote Lecture 4

### Computer Aided-Visual Perception : Challenges and Perspectives



#### Professor Nikos Paragios

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**Abstract:** Computer aided human perception aims at developing intelligent algorithms towards understanding visual cues coming from images, video, or other means of gathering visual information. Such a process often consists of three stages, initially the problem of perception is parameterized through a mathematical model where the estimation of its parameters will lead to visual understanding. Then, the model is associated with the available observations through the definition of an objective function and last, this function is optimized using computational methods. The main challenges that one has to address in this context is the curses of dimensionality, non-linearity, non-convexity and modularity. In simple words, even the simplest possible perception problem could involve too many parameters where the association between the data and them is not straightforward and is done through non-convex functions. In this talk, we will present a generic mathematical framework that exploits recent advances in discrete optimization to address computational visual perception. Numerous image processing, computer-aided diagnosis and computer vision applications will be considered to demonstrate the potentials of this method.

**Brief Biography of the Speaker:** Nikos Paragios (<http://vision.mas.ecp.fr>) obtained his B.Sc. (highest honors, valedictorian) and M.Sc. (highest honors) in Computer Science from the University of Crete (Greece) [1994,1996], his Ph.D. in electrical and computer engineering from I.N.R.I.A. [2000] and his D.Sc. (Habilitation a Diriger de Recherches) from the University of Nice/Sophia Antipolis (France) [2005]. He is professor of applied mathematics at the Ecole Centrale de Paris - one of most exclusive engineering schools "Grande Ecoles" - leading the Medical Imaging and Computer Vision Group. He is also affiliated with INRIA Saclay Ile-de-France, the French Research Institute in Informatics and Control heading the GALEN group. Prior to that he was professor/(2004-2005) at the Ecole Nationale de Ponts et Chaussees, affiliated with Siemens Corporate Research (Princeton, NJ, 1999-2004) as a project manager, senior research scientist and research scientist. In 2002 he was an adjunct professor at Rutgers University and in 2004 at New York University. N. Paragios was a visiting professor at Yale University in 2007. Professor Paragios has co-edited four books, published more than hundred papers (DBLP server) in the most prestigious journals and conferences of medical imaging and computer vision, gave more than hundred invited lectures, and has twelve US issued patents and more than twenty pending. His work has approx 3,500 citations in googlescholar and approx 2,000 in scopus, and his H-number according to scholar is 28 and 24 according to scopus. He is a Senior member of IEEE, associate editor for the IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), area editor for the Computer Vision and Image Understanding Journal (CVIU) and member of the Editorial Board of the International Journal of Computer Vision (IJCV), the Medical Image Analysis Journal (MedIA) and the Journal of Mathematical Imaging and Vision (JMIV). Professor Paragios is one of the program chairs of the 11th European Conference in Computer Vision (ECCV'10, Heraklion, Crete). In 2008 N. Paragios was the laureate of one of Greece's highest honor for young academics and scientists of nationality or descent (world-wide), the Bodossaki Foundation Prize in the field of applied sciences. In 2006, he was named one of the top 35 innovators in science and technology under the age of 35 from the MIT's Technology Review magazine. He and his collaborators were the recipients of numerous scientific rewards, like for example the Francois Erbsmann prize for the IPMI'07 conference. His research interests are in the areas of computer vision, medical image analysis and human-computer interaction.

## Keynote Lecture 5

### Control and Estimation Theory: Current Trends, New Challenges, & Directions for the Future



#### Professor Lena Valavani

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**Abstract:** Despite the tremendous strides witnessed in the Control and Estimation of lumped parameter systems, whether linear or nonlinear, the issue of stability and performance robustness under simultaneous structured and unstructured uncertainty still remains largely unresolved. When fault tolerance, autonomy and reactivity are added to the requirements, this presents an additional challenge. 'Closed form' solutions are in most cases not possible and computational methods (optimization based, search, etc.) do not provide the necessary guarantees.

The challenges become even greater in the case of distributed systems and networks, such as large industrial/manufacturing plants, environmental applications (CO<sub>2</sub> sequestration), communications networks, traffic networks (aeronautical, highway), space networks (satellite constellations), biomedical applications (CNS studies) which, by their nature, require control and estimation in a distributed setting. Requirements and specifications can also be widely variable between safety critical and socially/economically significant systems.

It becomes increasingly evident that control, communications and computation need to be synergistically combined through a 'universal formalism' and novel paradigms that combine logical operations (symbolic reasoning and decision making) with analytical constructs (mathematical algorithms) and continuous quantities (throughput, subsystem interconnections), in order to handle heterogeneity, asynchronicity, real time functionality, properties that typically characterize distributed systems/networks.

We focus on some representative examples to elucidate key issues that arise in modeling, algorithm design, computation, in order to ensure robustness, fault tolerance, autonomy and even reactivity of distributed systems/networks, that point to the need for total synergy of Control, Communications, and Computation/Computer Science- to meet today's and future challenges.

**Brief Biography of the Speaker:** Lena Valavani holds her B.S. in Physics, from Barnard College, Columbia University, and the M.S., M.Phil. and Ph.D degrees in Engineering and Applied Science from Yale University. After postdoctoral positions at Yale and MIT's Laboratory for Information and Decision Systems, she joined the Department of Aeronautics and Astronautics, MIT, where she was Boeing Associate Professor. She also served as Chief Scientist, Systems Engineering, U.S. D U.S. Department of Transportation for four years. She is currently president of Hellenic Space Systems, S.A.

Dr. Valavani served as Associate Editor of IEEE Transactions of Automatic Control, Automatica, AIAA Journal of Guidance, Navigation and Control, and the International Journal on Robust and Nonlinear Control. She was elected to the Board of Directors, AIAA, N.E., and served as General Secretary. She also was for a long time a member of the steering committee of the International Physicians for the Prevention of Nuclear War, GBPSR, (1985 Nobel Peace Prize).

Her research interests are in modeling for, and the analysis and synthesis of control systems, estimation and identification, with emphasis on robustness to structured and unstructured uncertainty, fault tolerance and reconfiguration, currently in distributed systems and networks. Her research in the U.S. was supported by NASA, NSF, AFOSR, ONR, and by private industry, resulting in innovative designs of prototype systems currently in operation in the U.S; in Europe by ESA and EC. She has supervised 27 Ph.D and 29 M.S theses at MIT, and 22 M.S. theses at NTUA and UoA.

Dr. Valavani was consultant to Lincoln Laboratory, C.S. Draper Laboratory, and Bell Helicopter while in the U.S. She received the Best Research Paper Award (1991) from the International Gas Turbine Institute and holds three U.S. Patents in the area of controlling unsteady aerodynamic processes in compressors. She is an Associate Fellow of AIAA.

## Plenary Lecture 1

### Towards 2D Electronic Circuits in the Spatial Domain



#### Associate Professor Nicolas Ratier

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**Abstract:** Electronic circuits are, by nature, functions of one independent variable in the time domain. They operate (in the sense of differential operators) from an input signal  $e(t)$  to an output signal  $s(t)$ . In this sense, we can speak of the electronic circuits of an ODE (ordinary differential equation) with its associated initial condition.

We show, in this talk, that periodic circuits can be used to define a kind of 2D circuits in the spatial domain. These circuits operate as a PDE (partial differential equations) from an input signal  $f(x,y)$  to an output signal  $g(x,y)$ . The two independent variables are now the coordinate axes  $x$  and  $y$ . As to the initial conditions, they are replaced by boundary conditions.

We first present how to construct an electronic circuit of a linear PDE and how the boundary conditions are transposed to electronic elements. The discrete solution at each voltage node of this circuit converges towards the solution of the PDE  $g(x,y)$  for a given input signal  $f(x,y)$  when the number of periodic cells increases.

Next, we consider the reverse problem, i.e. to build the PDE of an electronic linear circuit. Electric conditions imposed at the boundary are converted into Dirichlet or Neumann conditions. The solution of this problem is based on an extension of an homogenization modelling method initially developed by theoretical mechanicians to study composite materials.

**Brief Biography of the Speaker:** Nicolas Ratier was born in Paris in 1965. He is graduated in electronics at Paris XI University, Orsay. In 1993, he received the Ph. D. degree in microelectronics from Toulouse III University for his work on the simulation of micromechanical capacitive pressure sensors. He is associated professor at ENSMM (graduate engineering school in Mechanics and Microtechnics) and at FEMTO-ST laboratory, both at Besancon, France. From 1994 to 2006, his primary research activities were the simulation of ultrastable quartz crystal oscillators. Most of these researches have been completed in the framework of contracts executed for the french space agency (CNES). Since 2007, his current research concerns the study of spatially distributed periodic electronic circuits to control array of MEMS.

## Plenary Lecture 2

### Electronic Circuits for Switching-Time Reduction of Bipolar Semiconductor Devices



**Professor Noel Y. A. Shamas**

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**Abstract:** Bipolar semiconductor devices are often used as switches in very high power electronic circuits and systems. They have replaced the old conventional gas filled tubes and vacuum devices in many applications. This is mainly due to the fact that solid-state devices are more efficient, smaller in size, cheaper and more reliable. In addition, solid-state devices are considered environmental friendly, since they do not contain nasty gases and toxic materials used in old devices.

The power level requirements and switching frequency are continually increasing in the power electronic industry, and this demands larger and faster switching devices. As a result, both bipolar and unipolar semiconductor devices have undergone continued improvement in current and voltage ratings, and switching speed. The main advantage of bipolar devices is their low conduction losses but their main disadvantage is the high switching losses which is due to minority carrier injection.

The Insulated Gate Bipolar Transistor (IGBT) combines the advantages of both. It has a simple gate drive circuit like that of the MOSFET, with high current and low saturation voltage capability of bipolar transistor. The main problem remains with the relatively long tail turn-off current. To reduce the turn-off time of the IGBT and other bipolar devices, different lifetime control techniques and structural changes have been developed and used. Details of these and new techniques developed by using auxiliary electronic circuits for reducing the turn-off time and increasing the switching speed of bipolar semiconductor devices will be presented.

**Brief Biography of the Speaker:** Noel Shamas is currently a Professor in Microelectronics and Solid-State Power Semiconductor Devices in the faculty of Computing, Engineering and Advanced Technology, Staffordshire University. He received the M.Sc and Ph.D degrees from Salford University in 1972 and 1975 respectively. Since then he lectured and researched at different universities and industry.

Research work is primarily focused on Power Semiconductor Devices which includes mainly Power diodes, Light Emitting Diodes (LED's), Insulated Gate Bipolar Transistors and Thyristors. Other related areas of research work includes Power Module Packaging technologies ( Both Conventional Press- pack and Smart pack designs) and Series/Parallel operation of high power semiconductor devices and their interaction with external circuits.

Professor Shamas has extensive experience in both experimental and theoretical research work and is recognised internationally for his significant contribution to research in the field of Power Semiconductor Devices. He has published over 120 journal and conference research papers as well as several invited Keynote Lectures, and has held several research grants from funding councils, Advantage West Midland (AWM), as well as from industry. He is a regular reviewer for many journals (including IEE Proceeding Electronic devices and systems, IEEE Transactions on power electronics, and Microelectronic Reliability) and international conferences (including the European Power Electronic conference - EPE, Microelectronic conference - MIEL, Universities Power Engineering Conference-UPEC, International Symposium Power Semiconductors-ISPS, etc...). He is a member of scientific committee for many international conferences (including MIEL, EPE, WCE, WSEAS, and Microtherm) and a steering committee member for EPE, UPEC, and ISPS international conferences. He is also a book reviewer for Prentice Hall International and McGraw Hill.